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Monitoring Accounts Receivable Revisited

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MONITORING ACCOUNTS RECEIVABLE REVISITED

ABSTRACT

In analyzing a model designed by Carpenter and Miller [4] to measure the relative contribution of sales pattern and collection experience effects to changes in accounts receivable, we discovered a measurement error and the presence of a joint interaction effect. We review briefly the literature related to investing in accounts receivable and to monitoring the growth and level of accounts receivable. The measurement error in the CM model is identified and the presence of a joint effect is introduced. A revised model presents algorithms for measuring sales, collection and joint effects that underly a change in accounts receivable. The revised model can be used for monitoring and controlling accounts receivable.

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Monitoring Accounts Receivable Revisited

Credit managers and researchers have a common interest in designing models that monitor the rate of growth and level of accounts receivable plus measuring the investment performance of receivables. There is extensive literature showing that both days sales outstanding (DSO) and the aging schedule of accounts receivable are dependent on sales and, therefore, are not reliable measures for monitoring and controlling changes in accounts receivable, e.g., Lewellen and Johnson [10], Lewellen and Edmister [11], Freitas [7], and Stone [15]. Customer payment patterns have been identified as the key information source for monitoring and controlling accounts receivable, Cyert, Davidson and Thompson [5], Beranek [2], Cyert and Thompson [6], Lewellen and Johnson [10], Lewellen and Edmister [11], Freitas [7], and Stone [15]. In contrast, the literature has made only modest reference to the effect changes in sales patterns have on changes in accounts receivable.

In 1979 Carpenter and Miller (CM) [4] presented a framework that relates changes in receivables to either a sales pattern effect and/or a collection experience effect. The CM analytical framework was based on a weighted DSO concept that was independent of both sales averaging and the pattern of sales. CM not only measured the change in receivables due to changes in collection experience and sales patterns, but they also compared actual DSO and actual receivables to a standard. With the CM model credit managers could determine the relative contribution of a sales effect and/or a collection effect to changes in receivables. The CM model provided management a tool to improve the control of accounts receivables and the forecast of cash flows.

Although the CM model is a significant contribution to the financial management literature, we have discovered a measurement error and the presence of a third effect, which we call a joint effect. Our revisions to the CM model provides a more precise explanation of changes in accounts receivable. Thus a reexamination of the CM model is warranted.

Our objectives are to review briefly the literature for monitoring and controlling accounts receivable; to highlight the components of the CM model and to show CM's measurement error; to introduce the presence of a joint interaction effect; and to provide a revised algorithm to the CM model.

Literature Review

In measuring the investment performance of receivables Sartoris and Hill [13] developed a theoretical model that captures the valuation effects of credit policies on the cash flows generated from receivables. Additionally, Kim and Atkins [9] and Atkins and Kim [1] provides a net present value model for evaluating the performance of investments in accounts receivable.

From the monitoring perspective, Cyert, Davidson and Thompson [5], Beranek [2] and Cyert and Thompson [6] found that a steady state transition matrix in a Markov chain model closely approximates the payment pattern process underlying accounts receivable behavior. They also found the transition matrix provides valuable insight for improving the management of accounts receivable. Finally, a most important observation was that the underlying payment pattern behavior is independent of fluctuations in sales.

In the mid 1970s Lewellen and Johnson [10], Lewellen and Edmister [11], Freitas [7] and Stone [15] identified the fact that days sales outstanding (DSO) and the aging schedule--two key management credit control measures--are unreliable because of their close dependence on sales patterns. They observed customer payment behavior and the trend of sales are the key independent measures of accounts receivable performance. The authors recognized that a firm's collection patterns are not in a continuous steady state condition due to seasonal, cyclical or random events. Corcoran [3] extended the earlier models by introducing dynamic payment pattern behavior. Utilizing the Cyert, Davidson and Thompson (CDT) Markov chain system, Corcoran modeled the transition matrix as an expotentially smoothed or weighted average of the previous month's transition matrices. However, Corcoran did not indicate what set of conditions are best for using his model or the basis for the weights chosen.

In 1981 there was another modification to the original CDT model. In aging receivables CDT assumed the presence of a total balance method where the age of the receivables from a specific account is based on its oldest receivable outstanding. This method tended to underestimate actual cash inflows from receivables. Van Kuelen, Spronk and Corcoran [16] revised the CDT model to use partial aging in classifying accounts in place of the total balance method.

Karlberg and Saunders [8] expanded the dynamic transition matrix by modeling changes in individual customer payment behavior. The Karlberg and Saunders (KS) model tracks payment behavior of individual customers over time in contrast to tracking dollars in an aging category. Most importantly the KS model provides substantive insights into the behavior

of accounts receivable and their empirical tests show the relatively unstable nature of collection patterns.

Shim [14] developed a lagged regression approach to measure the cash collection rates and bad debt expense rates by relating cash collections to credit sales of prior periods. He also showed how the regression results can be used to develop a probabilistic budget.

Shim [14] and Karlberg and Saunders [8] utilized different techniques to measure collection pattern behavior and to show empirically that the investment in accounts receivable and the flow of cash from receivables are closely related to changes in a firm's collection experience.

Carpenter and Miller [4] attacked the primary concern of financial and credit managers, that is what causes changes in accounts receivable. CM's model determines if a change in receivables is related to a change in sales growth and/or a change in collection experience. A standard collection pattern and a weighted DSO were the underlying basis for determining the sales and collection effects.

CM's Measurement Error

In measuring the change in accounts receivable CM presented a framework that includes a sales pattern effect (SPE) and a collection experience effect (CEE). These two effects can be summarized as follows:

$$SPE = \Delta\text{Sales} \times \text{Collection Experience}(t_i), \tag{1}$$

$$CEE = \Delta\ \text{Collection Experience} \times \text{Sales}(t_j). \tag{2}$$

The symbol Δ stands for the difference between a value in t_j and a standard benchmark in time t_i. These two equations, however, ignore a

joint effect that emerges exclusively from the interaction of the change in the sales pattern and the change in the collection experience. This combination effect contributes directly to the change in accounts receivable. To illustrate, let us consider the net change in accounts receivable for the months of March and June. All of our examples are based on an exhibit developed by Carpenter and Miller [4, p. 39].

	March	June	Net Changes in Receivables
Sales	$60	$90	
% of sales outstanding at end of period	0.90	0.80	
Accounts receivable	$54	$72	+ $18

From equation (1) we find the sales pattern effect is

$$(\$90-\$60)(0.90) = +\$27,$$

and from equation (2) we determine the collection experience effect is

$$(0.80-0.90)(\$90) = -\$9.$$

Thus, CM attribute the +$18 net change in accounts receivable ($27 + ($-9) = $18) to a $27 increase, caused by an incremental increase in sales, and to a $9 decrease, caused by an improvement in collection experience.

The top two-thirds of Exhibit 1 geometrically depicts what actually happened to accounts receivable in March and June. It can be observed that whether the original CM model or the revised version is used, the net change in accounts receivable remains unchanged at $18. However, in the revised model in the lower one-third of Exhibit 1 the sales pattern effect changes to $24 from $27 in the CM model and the collection

experience effect changes to -$6 from -$9 in the CM model. This divergence from CM's model may be explained by splitting equations (1) and (2) into two components as follows:

Sales pattern effect	= ($30)(0.8)	+ ($30)(0.1)	= $27
Collection experience effect	= (-0.1)($60)	- (0.1)($30)	= -$ 9
Net change in accounts receivables			= +$18

Comparing the information in the lower one-third of Exhibit 1 to the preceding equations, it can be seen that the left term in both equations matches the shaded areas, while the right term matches the area of a corner that does not exist. CM's equation (1) assigns the $3 account receivable corner to the sales pattern effect and then, their equation (2) subtracts the same account receivable corner from the collection experience effect, thereby cancelling each other and resulting in a net change in accounts receivable of $18. In summary, for the above example the original CM model overstates the sales pattern effect and understates the collection experience effect.

Joint Effect

In Exhibit 1 the change in receivables is explained by a collection effect and a sales effect, where one was positive and the other negative. Exhibit 2 shows a reduction in receivables of $48 that is directly related to a sales pattern effect. That is, sales decreased from $90 in June to $30 in September and the collection experience pattern remained unchanged at 0.8. Exhibit 3 illustrates a $6 reduction in receivables that is directly attributed to a collection experience effect. That is, there was a reduction in the percent of sales held in receivables from 60% to 50%, i.e., an improvement in collection

experience, and sales remained constant at $60. Exhibits 1 through 3 illustrate changes in receivables that can be totally explained by a collection experience effect, a sales pattern effect or a combination of the two effects, when one is positive and the other negative. However, when both effects are negative or positive, a joint effect is introduced.

The change in accounts receivable that we attribute to a joint effect is graphically located in the lower one-third of Exhibit 4 where the collection and sales effects overlap. In equation form the joint effect (JE) is defined as follows:

$$JE = \Delta\text{Sales} \times \Delta\text{Collection Experience}. \qquad (3)$$

Using the months of December and September CM's equation (1) computes a sales pattern of $24 ($30 x 0.8) and equation (2) generates a collection experience effect of $6 (0.1 x $60). The net changes in receivables is $30 ($24 + $6). The revised model in Exhibit 4 shows that the sales effect is $24, which is identical to CM's calculation. However, the revised model in Exhibit 4 determines that the collection experience effect is $3 (0.1 x $30) and the joint effect is $3 (0.1 x $30). In comparing the two collection effects, it can be observed that CM's equations assign the $3 joint effect to the collection experience effect. It also can be deducted from Equations 1 and 2 that CM's model allocates the joint effect to the sales pattern effect when there is a reduction in sales and an improvement in the collection experience. Exhibit 4 illustrates that the joint effect is a combination of the sales and collection effects. Thus CM's model for the above set of

conditions overstates the collection experience effect and does not include the joint effect.

Revised Algorithms

A revised model is presented in Exhibit 5 that measures the seven possible combinations of sales, collection and joint effects which cause changes in accounts receivables. A brief discussion of Exhibit 5 will aid in its interpretation. In the matrix at the top of Exhibit 5, condition 1 is located in two cells. Condition 1 occurs when there is no change in the sales pattern, but the collection experience can either be improving or deteriorating. When the collection experience is improving, the percentage of sales held in receivables is reduced. For example, when the collection experience improves from 60 percent of sales outstanding to 50 percent and sales remain constant, as shown in Exhibit 3, there is a reduction in receivables. The reverse case, where the collection experience deteriorates and sales remain constant, result in an increase in receivables. The algorithm for measuring the collection effect under condition 1 is listed below the matrix in Exhibit 5.

Condition 2 illustrates a change in receivables that is related only to a change in sales pattern with no change in collection experience. Exhibit 2 highlights one dimension of condition 2 where the sales pattern decreased. The reduction in receivables is directly related to the decrease in sales. In contrast, receivables can increase as a direct result of an increase in sales. The algorithm for measuring the dimension of the sales pattern effect on receivables under condition 2 is listed below the matrix in Exhibit 5.

The worst case for receivables management is found in condition 3 where sales are increasing and collection experience is deteriorating. In condition 3 all three effects are present and they are illustrated in the lower one-third of Exhihit 4. In order to determine the three separate effects that exist under condition 3, a three part algorithm is necessary. This algorithm is listed to the right side of condition 3 in Exhibit 5.

Under condition 4 collection experience is improving, but sales are down. Intuitively this means lower receivables. In order to measure the contribution of the collection, sales and joint effects, it is necessary to utilize the algorithm in Exhibit 5 listed to the right of condition 4.

The scenario where collection experience deteriorates and sales decline is found in condition 5. A more positive scenario where collection experience has improved and sales are up is represented under condition 6 and graphically shown in the lower one-third of Exhibit 1. Condition 7 reflects the case where the collection experience and the sales pattern are unchanged. The algorithm for measuring the sales and collection effects under these three conditions are found in Exhibit 5.

Conclusions

The revised model provides algorithms for measuring the collection, sales and joint effects that underly changes in accounts receivable. Although the relationships are complex, the revised model supplies financial managers and credit analysts a tool for monitoring and controlling accounts receivable. This model also defines the foundations in which a similar contribution analysis for accounts payable and inventories in the cash conversion cycle by Richards and Laughlin [12] can be developed.

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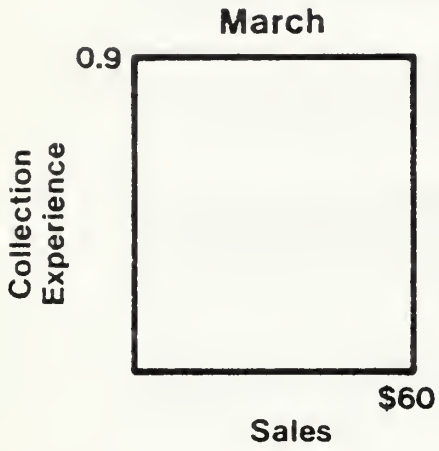
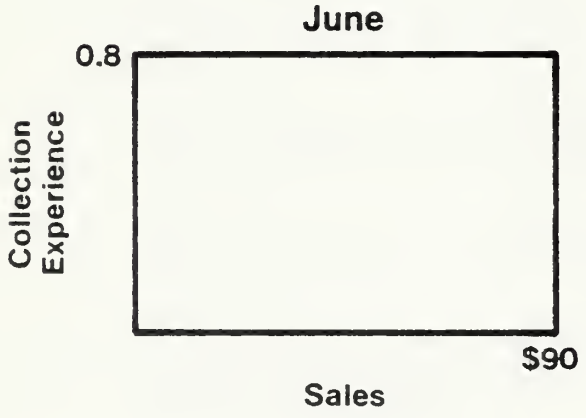
EXHIBIT 1

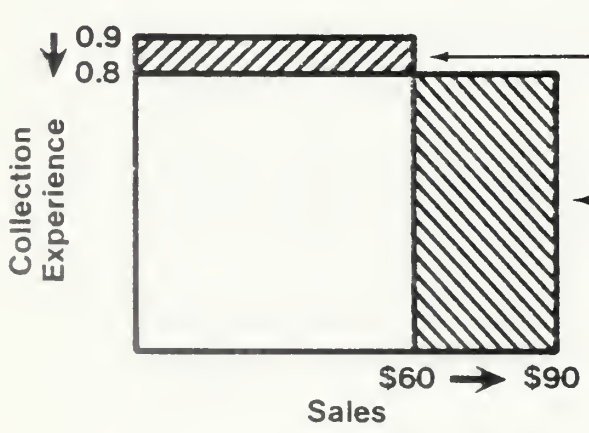
Collection Experience Effect and Sales Pattern Effect



Total Receivables = (0.9)($60) = $54



Total Receivables = (0.8)($90) = $72

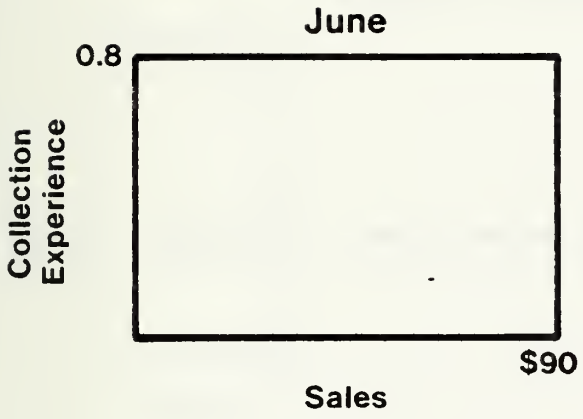


Collection Experience Effect
(−0.1)($60) = −$ 6

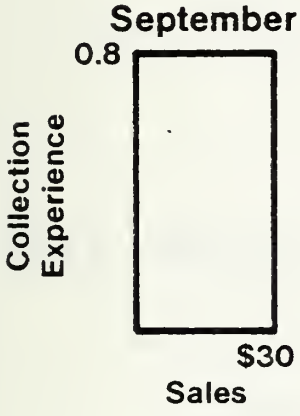
Sales Pattern Effect
($30)(0.8) = $24

Net Change in Receivables $18

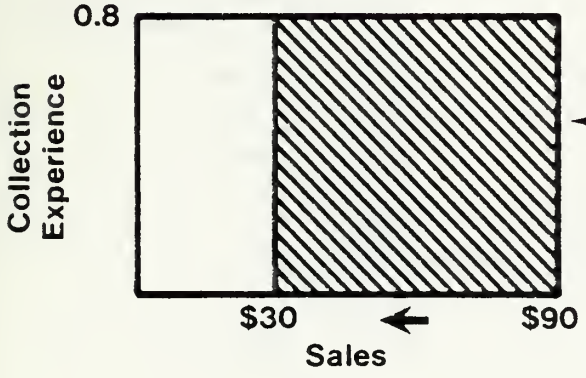
EXHIBIT 2
Sales Pattern Effect



Total Receivables = (0.8)($90) = $72



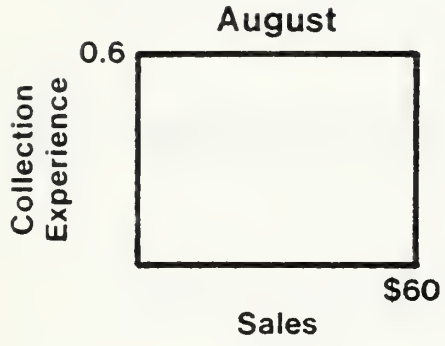
Total Receivables = (0.8)($30) = $24



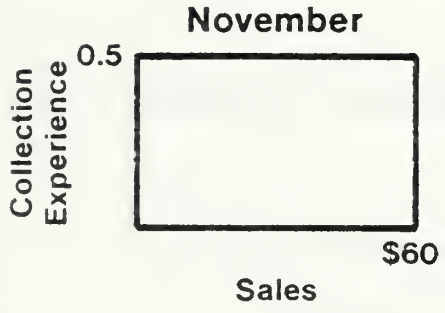
Sales Pattern Effect
(−$60)(0.8) = −$48

Net Change in
Receivables −$48

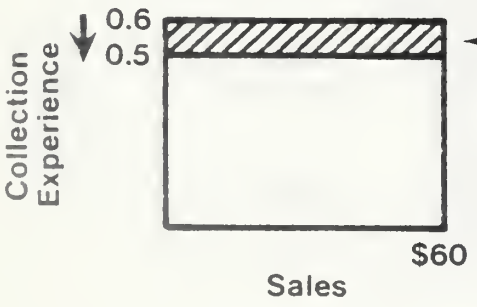
EXHIBIT 3
Collection Experience Effect



Total Receivables = (0.6)($60) = $36



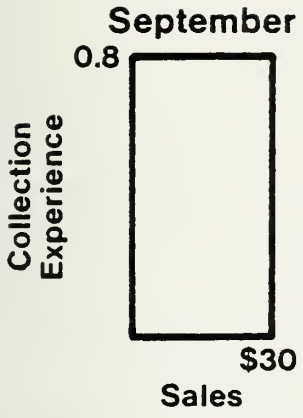
Total Receivables = (0.5)($60) = $30



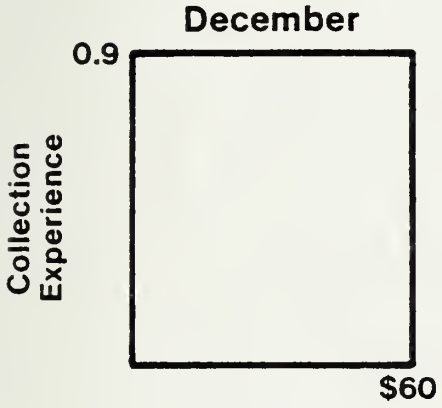
Collection Experience Effect
(−0.1)($60) = −$ 6

Net Change in
Receivables −$ 6

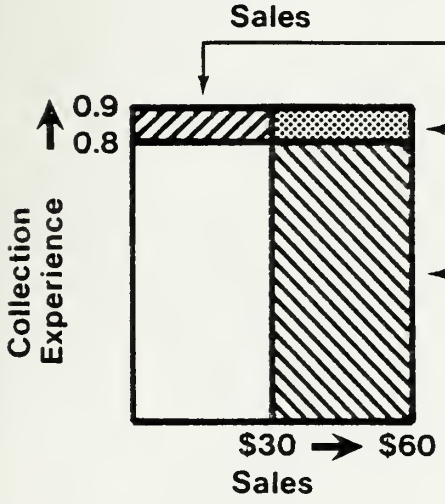
EXHIBIT 4
The Three Effects



Total Receivables = (0.8)($30) = $24



Total Receivables = (0.9)($60) = $54



Collection Experience Effect
(0.1)($30) = $ 3

Joint Effect
(0.1)($30) = $ 3

Sales Pattern Effect
($30)(0.8) = $24

Net Change in Receivables $30

Exhibit 5

Revised Algorithms for Measuring the Effects
That Cause a Change in Accounts Receivable

Collection Experience (CE)	Sales Pattern (S): up (↑)	no change (NC)	down (↓)
deteriorate (↑)	3	1	5
no change (NC)	2	7	2
improve (↓)	6	1	4

Condition	Description	Effect		Algorithm[1]
1	↑ or ↓ in CE and NC in S	Collection	=	$\Delta CE \times S_i$
2	↑ or ↓ in S and NC in CE	Sales	=	$\Delta S \times CE_i$
3	↑ in CE and ↑ in S	Sales	=	$\Delta S \times CE_i$
		Collection	=	$\Delta CE \times S_i$
		Joint	=	$\Delta S \times \Delta CE$
4	↓ in CE and ↓ in S	Sales	=	$\Delta S \times CE_j$
		Collection	=	$\Delta CE \times S_j$
		Joint	=	$-\Delta S \times \Delta CE$
5	↑ in CE and ↓ in S	Sales	=	$\Delta S \times CE_i$
		Collection	=	$\Delta CE \times S_j$
6	↓ in CE and ↑ in S	Sales	=	$\Delta S \times CE_j$
		Collection	=	$\Delta CE \times S_i$
7	NC in CE or S	All	=	0

[1] i represents the period in which the standard S or CE occurred. The S or CE in period j is compared to the Standard S or CE in period i.

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